

DD/A  
85-2199

## ROUTING AND RECORD SHEET

SUBJECT: (Optional)

Permanent Tie-Back Wall

FROM:

DC/NBPO/OL  
1J45 HQ

EXTENSION

4246

NO.

20240-85

DATE

14 June 85

TO: (Officer designation, room number, and building)

DATE

RECEIVED

FORWARDED

OFFICER'S INITIALS

COMMENTS (Number each comment to show from whom to whom. Draw a line across column after each comment.)

1. D/OL *1/EO/EO DD/A*  
2B07 Page2. *A/EO/DDA*3. ADDA  
7C18 HQ

4.

*DDA*

5.

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11.

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1 &amp; 3: FYI. The attached correspondence from SH&amp;G may clarify recent discussions on the tie-back wall.

Attachment

DD/A REGISTRY  
FILE: *45-8*

June 6, 1985  
13155

85-2199

Central Intelligence Agency  
New Building Project Office  
Room 3E40  
CIA Headquarters Building  
Washington, D.C. 20505

STAT  
Attention:

Re: Permanent Tieback Wall  
Log 964

Gentlemen:

We received the final Detensioning Reports on April 17, 1985 which permitted conclusion of Mr. U. Stoll's final report dated May 23, 1985 on the permanent tieback wall. We submit herewith five copies of the report in three volumes for your use. On pages 2 and 3 are the conclusions regarding the structural integrity of the wall.

We concur with Mr. Stoll that the tieback wall is structurally sound and will perform as designed. In response to your letter of April 8, 1985, we believe that protective devices are not required to prevent the anchor rod from becoming a projectile. Rupturing of the rod which can cause the free end to propel outward will not occur as long as the rod stress is below failure stress limit. All ties have reached equilibrium and are loaded within design load criteria. In addition, the ties are encased and waterproofed to protect against possible structural deterioration.

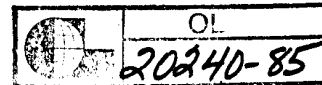
We will keep one set of field reports on this permanent tieback wall in our files for record purposes.

Please call if you have any questions regarding this matter.

Very truly yours,

  
Wm. Everett Medling, AIA  
Project Manager

WEM:jeb  
Enclosures (5 copies)



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DONALD F. ESCHMAN, Ph.D.

May 23, 1985

Mr. Nolasco Angeles, Sr.  
Smith, Hinchman & Grylls, Inc.  
455 West Fort Street  
Detroit, MI 48226

SUBJECT: Analysis of Field Observations  
Tie Back Wall  
CIA Headquarters Expansion  
Langley, Virginia

REFERENCE: (1) Letter from [ ] CIA to  
W. E. Medling, SH&G, dated  
January 3, 1985  
(2) Letter from Medling to Moran,  
dated February 8, 1985

Dear Sir:

This letter-report sets forth Conclusions and supporting  
Discussion and Comments based on analysis of the following:

Appendix A. Inclinator profile charts - Piles 38, 60, 73  
and 82; August 15, 1984 - March 1, 1985 (97 sheets).

Appendix B. Comparative inclinometer profiles with in-  
dicated load cell readings (19 sheets attached).

Appendix C. Compiled load cell readings - 25 cells at  
piles 38, 60, 73 and 82; August 21, 1984 to May 20, 1985  
(102 sheets).

Appendix D-1. Graphical summary load cell trends, October  
18, 1984 to May 20, 1985 (28 sheets attached).

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Appendix D-2. Log time trends of critical tie loading (2 sheets attached).

Appendix E-1. Compilation of tie unseating/detensioning loading and retraction displacement (142 on October 12-17, 1984, 64 on October 30 - November 1, 1984, 97 on November 13-15, 1984, 66 on December 19, 1984, 135 on March 9-13, 1985, 11 on April 13, 1985) (25 sheets attached).

Appendix E-2. Summary of Tie unseating and Detensioning Activity (soldier piles 13 thru 100) (30 sheets attached).

Your office has previously received copies of the tie anchor proof test data and duplicate records will not be included here.

### Conclusions

Based on our final evaluation of the field observations discussed below in some detail, we reaffirm your previous response to Mr. Moran's concerns (see above referenced correspondence). Specifically:

- (1) The tie back wall has been and is safe. All field observations, including those appended, have and continue to indicate safe conditions, with no evidence of changes which might lead to a reduction in the safety factor.
- (2) There have been no reported instances of structural failure of any tie anchor rods or their anchorage hardware since inception of project. Field observations indicate ties have reached equilibrium at well below the maximum load limits. There is no evidence to date of corrosion or physical deterioration of any kind and the protective means provided are effective and appropriate to the actual site construction.

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- (3) Since field evidence is that the tie anchor loads have achieved load equilibrium and analysis of field measurements indicate adequate safety margin for loads on all ties, there is no need for considering installing additional tie anchors.
- (4) The field evidence is that the tie anchors have achieved load equilibrium, that the final structure will not impose additional loads on the ties, and that the wall and floor system would provide for additional capacity for re-distributing localized lateral load increases in the unlikely event this occurs. Consequently, there is no apparent need for on-going field monitoring and the expense and difficulty of operating and monitoring such a system is not deemed to be justified in these circumstances.

#### Discussion and Comments

Appendix A and B include inclinometer profiles at four representative soldier pile locations. Observations span the period during excavation and installation of successive tiers of tie anchors (i.e. prior to October 15, 1984) and for the subsequent 5½ months (i.e. thru March 1, 1985). The following is noteworthy:

- (1) Appreciable lateral displacement occurred in course of excavating the weathered rock (i.e. saprolite), up to a maximum 25 to 30 mm. See Appendix B, Sheet A-4, B-5, C-5, Elevation 215 to 245.
- (2) Lateral displacements were direct consequence of excavation, with no discernible evidence of ongoing displacement during periods between additional excavation. See Appendix B, Sheet A-2, September 21 & 27, Sheet B-2, September 12 & 17, etc.
- (3) Lateral displacement as excavation was deepened caused appreciable load increase in the previously installed ad-

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joining ties, ranging up to 10 to 13 tons greater than original 56 ton lock off load.. See Appendix B, Sheet A-3, October 15, load cells at elevations 220 (66.9 tons), 230 (69.4 tons) and 240 (67.3 tons).

- (4) Comparative inclinometer profiles subsequent to completion of excavation (i.e. October 15, 1984 thru March 1, 1985) indicate no discernible evidence of additional lateral displacement. See Appendix B, Sheets A-4, B-5, C-5, D-5. Note that accuracy limits of inclinometer profiles are about  $\pm 0.10$  inches, and certain tie load cells showed small rapidly decelerating increases in tie loads, with attendant lateral soil movements too small to be picked up by the inclinometer.
- (5) Although the upper, cantilever extension of certain soldier piles moved appreciably (i.e. 1 to 2 inches, P-38 and 60), these were deemed normal response to anticipated active earth pressures and the attendant lateral displacement in underlying saprolite during excavation.

The writer concludes that the lateral deflections and attendant load cells response during excavations for the bed rock wall were due to local expansion of the saprolite, most likely involving a mechanical shifting of the exposed rock along steeply inclined fracture planes. Such movements are typically rapid and quickly attenuating, as a more stable mechanical rearrangement develops with small additional strains.

Appendix C is a tabulation of the readings of 25 load cells installed with tie anchors at the four soldier piles containing inclinometer tubing. Readings have been taken at from 2 to 7 day intervals from installation date through May 20, 1985. A graphical summary of cell readings is shown in Appendix D-1, covering the seven months subsequent to wall excavation (i.e. October 18 to present), with scheduled unseating and detensioning events

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indicated. Log time-load plots for four of the more critical load cells is in Appendix D-2.

Following is noteworthy:

- (1) Ties which retained the zone B soil (i.e. above elevation 245) and the relatively intact Zone D rock (i.e. below elevation 215) reached equilibrium load within a few weeks of completing excavation. See trends, Appendix D-1.
- (2) Ties within the Zone C saprolite showed discernible load increases for periods up to 5 to 6 months after construction, but at a rapidly and consistently reduced rate of increase. See particularly Appendix D-2 for Pile 73 ties, elevations 225 and 235, and Pile 82 ties, elevations 220 and 230.
- (3) Precise evaluation of small changes in cell loads is problematical due to temperature effects and/or instrument reading fluctuation. See Appendix D-2, December 15 to February 15, 1985).
- (4) In all but one instance (i.e. P-60, elevation 230, 63.1 tons), the final cell load limit was less than 63, providing an acceptable margin below the minimum proof load 68 tons.
- (5) The consistently decelerating increases in tie loads over an extended period indicate a sharp increase in internal confining reactions with a small (i.e. practically indiscernible) accompanying lateral strain. There is no evidence of a deteriorating component of internal earth resistance during this period.

Appendix E-1 compiles the several rounds of tie detensioning observations, including unseating loads and the corresponding roughly measured retraction of the end of the tie rod when loads were reduced. It must be emphasized that the "unseating load" was based on appearance of a visible gap between the tie retaining nut

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and bearing plate and noting the estimated load applied by the calibrated jack assembly. Comparison between indicated load cell readings and reported unseating loads indicate the latter was an average of about 3 tons greater than the former. (i.e. 0 to 6 tons greater). This tendency for over reading of tie loads by the unseating jack must be kept in mind when interpreting the successive loads determined in course of unseating particular ties, as compiled in Appendix E-2.

The following is noteworthy:

- (A) The largest tie load increase occurred during construction (i.e. before October 15) coinciding with excavation of weathered rock (between soldier piles 31 and 74 and tiers 5 and 10 (i.e. elevation 245 and 220)).
- (B) Of the 110 ties which were detensioned two or more times after completion of excavation (after October 15), the maximum subsequent reported unseating load was 63.9 (i.e. Pile 52, tier 12, March 9-14) with the remaining ties indicating 62 or less load. However, this largest unseating load is suspect, particularly noting that with the jack assembly used, it was not possible to unseat ties at Pile 49, tier 9 and Pile 51, tier 9, under with 75 tons indicated, whereas unseating was achieved at 70.2 and 72.9 tons respectively on a subsequent attempt on April 13. This reaffirms that detensioning jack loads are not particularly accurate nor consistent. Consequently, the significance of reported load fluctuations is suspect.
- (C) We note that the most probable upper limits of post construction developed tie load increases at about 5 tons, which is close to that observed in load cell at Pile 82, elevation 220 during the period November 1 thru May 20 (See Appendix D-2), currently in equilibrium.

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- (D) There are several instances where the unseating loads are appreciably less than the reported prior lock off loads. Since each of these ties had previously been successfully proof loaded, the writer ascribes such indicated load drop off to possibly under shooting the lock off load during a preceeding detensioning or due to small yielding of the soil reacting against the soldier pile, recognizing that yielding of less than 0.15 inches would be sufficient to account for the range of tie load decreases observed.
- (E) Analysis of the measured retraction of the end of anchor ties in course of detensioning (Appendix E-1) indicate essentially all ties developed anchor reaction involving less than half of the grout bonded portion. This would confirm a comfortable safety factor against soil/grout bond failure under the design lock off load.

This completes that requested reaffirmation of Conclusions and supporting Discussion and Comments. If there are any additional questions or concerns, please do not hesitate to contact the writer.

Very truly yours,

STOLL, EVANS, WOODS & ASSOCIATES



Ulrich W. Stoll, P.E.

UWS:jam  
Enclosures

cc: Professor George Sowers

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